



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

THE ECONOMIC IMPORTANCE OF THE SCIENTIFIC WORK OF THE GOVERNMENT. II

By Dr. EDWARD B. ROSA

CHIEF PHYSICIST, BUREAU OF STANDARDS

COOPERATION BY THE GOVERNMENT IN INDUSTRIAL RESEARCH AND STANDARDIZATION

The success of industrial research work by the government has been amply demonstrated. That government laboratories have done scientific and technical work of the highest quality, and done it efficiently and acceptably to the public, is generally admitted by those well qualified to speak. Their efficiency will not suffer in comparison with that of commercial organizations. It is doubtful if any commercial organization could approach the performance of government laboratories if the Board of Directors had maintained an inflexible and inadequate salary scale for all the more responsible technical and administrative positions as the government has done.

Scientists and engineers in the service of the government appreciate the opportunity of carrying on researches and constructing public works in the public interest, and of being able to make investigations and publish results unfettered by commercial considerations. In consideration of these advantages, many are willing to remain in the government service at less salary than could be earned elsewhere. Until recently the government has been able to retain its able men on the average nearly as well as the colleges and the industries. During the past few years, however, circumstances in this respect have changed. While the cost of living has nearly or quite doubled, and salaries in the industries and in many of the colleges have been considerably increased, government salaries have increased very little and in the higher grades not at all. The result is that in many cases men can not support their families, and are obliged to seek employment (or accept employment offered or urged upon them) at a living salary. In many cases men who are making a splendid success and have regarded the government service as their career, leave their positions from necessity and with the greatest reluctance. Often these positions can not be filled and the work suffers or ceases altogether. It is believed, however, that this condition

will not continue indefinitely. A readjustment of the salary scale must be made if the government is to have the services of a competent and permanent staff to conduct its scientific and administrative work. In view of the splendid success achieved in the past, it does not seem possible that this essential part of an effective government will be allowed to disintegrate and go to pieces. Industrial research conducted by the government with the active cooperation of the industries, and in some cases of the states, may be made even more important and successful in the future than in the past; for it is needed now more than ever, and is appreciated as never before.

In order to give a more concrete idea of the practical usefulness and economic importance of research and standardization, a number of special cases will be cited in the field of the Bureau of Standards. These cases are chosen partly because I am especially familiar with the work of this Bureau, and partly because there appears to be at this time especial need of the kind of constructive scientific research in the manufacturing industries which it is one of the functions of this Bureau to carry on. Equally striking examples could be cited in Agriculture or Mines or other lines of government research.

STANDARDIZATION AND RESEARCH IN THE BUILDING INDUSTRIES

For several years recently the building of homes has been almost suspended, and now there is a scarcity of houses in many cities. Meantime the cost of building has increased enormously, due to the greatly increased cost of labor and materials. In consequence real estate and rents have risen beyond all precedent. There never was a time when it was so necessary to use building materials intelligently, to reduce waste, to simplify design and construction, to standardize dimensions and methods, to make parts interchangeable and fit together readily, so as to economize labor and reduce costs. If standard specifications could be prepared and agreed upon in a much larger number of cases than has yet been done it would greatly facilitate the work of architects and builders; and if building methods and the requirements of city building codes could be thoroughly studied and revised this also would aid in reducing building costs. It seems probable that hundreds of millions of dollars could be saved within a few years if a comprehensive and intelligent study were made of all phases of building, including fire prevention and the plumbing, heating, lighting and hardware equipment of buildings. It would also re-

duce the cost of repairs and maintenance of these buildings; partly because deterioration would be slower and failures would be less frequent, and partly because repairs would be easier and cheaper to make. The government would do only a portion of this work of research and standardization, as many engineering societies, industrial organizations and manufacturers would cooperate. But the government should take the lead, and do an important part of the research work, and nothing which the government could do would be more useful and constructive, or would be more appreciated by the building industries and the public. Standardization work of the kind suggested has great educational value, to architects, to builders, to manufacturers, to jobbers, to building owners. It would tend to improve the design and methods of building, and would simplify many building problems as well as lower the cost. Is there any good reason why such a constructive program of cooperative study should not be undertaken? Can the people of this country afford to go on without it under present conditions?

STANDARDIZATION AND TESTING OF AUTOMOBILES

The automobile industry is one of the most important of our industries, and motor vehicles of all kinds play a most important part in the business and social life of the people. Several billions of dollars are expended each year in the purchase and maintenance of motor vehicles. Great improvements have been made in recent years in their design and construction; on the other hand, the quality of materials and workmanship has in many cases gone backward. Much progress has been made toward the standardization of the materials and parts of motor vehicles, and great credit is due to the automobile industry therefor. But there is great need for further systematic study and the preparation of specifications and tests, and the encouragement of testing so that purchasers may know better what they are buying and selling agents may describe their machines more precisely. The interests at stake are so enormous, and the possibilities of service to the public are so great, that it seems imperative that more should be done by the government to assist the industry in its great task.

GASOLINE AND MANUFACTURED GAS

Gasoline is getting scarcer and dearer every year, and yet not enough is being done in a systematic way to show how to

economize in the use of gasoline. A thorough investigation of carbureters and fuels, and certified tests of the performance of all makes of automobiles, would be a great value in economizing in the use of gasoline, and giving the public as much service as possible for a given expenditure. The Bureau of Mines and the Bureau of Standards have studied different phases of this question, but neither has been able to do as much as should be done. With millions of automobiles in daily use, and gasoline constantly rising in price and deteriorating in quality, can the public afford to have the government fall short in a matter of so great economic importance, and of serious personal concern to so many?

Manufactured gas is used for cooking and lighting by many millions of people and by the industries for scores of uses. A large part of this gas is made by the use of petroleum oil to enrich blue water gas of low heating value. Recently this gas oil has become scarcer and dearer, and it threatens to become still more expensive and perhaps impossible to get in sufficient quantity. That will necessitate the use of lower grades of oil, or the production of lower grades of gas, or a change of manufacturing equipment at enormous expense. Individual gas companies can not study so fundamental a question comprehensively; individual cities or states can not assume the responsibility of solving the problem for the entire country. The proper agency to take up this question is the federal government, with the cooperation of the gas companies and the oil companies and the state and municipal authorities. Such a comprehensive and constructive study would be of great value and would have the sympathy and support of all the important interests. It should include the matter of raw materials, manufacturing methods, and the relative usefulness of the various grades of gas that can be produced.

PUBLIC UTILITIES

The government should cooperate actively with gas and electric and railway and telephone companies in the study of the many engineering questions involved in rendering good service to the public. The changed economic conditions of recent years have made it impossible for many public utility companies to meet expenses. In some cases they have gone into the hands of receivers, in many other cases they escape by putting up rates. But advancing the rates beyond a certain point reduces the sales and does not give a proportionate

benefit. The public in the end must pay all the cost, and the public is vitally concerned in having efficient and economical management of these utilities. If the government could help the companies to help themselves, it would often be better than an increase in rates. The government could render a service of immense usefulness and importance by studying the problems of the public utilities and helping the companies to secure more efficient operation and a better understanding by the public of their difficulties and their needs. The utilities are a special kind of partnership between their owners and the public, in which the owners agree to furnish the plant and the service and the public grants a monopoly privilege and agrees to accept the service rendered and to pay the cost. If the company's credit is impaired or it fails altogether the community, as well as the company, suffers. It is evident, therefore, that the public should take a keen and intelligent interest in public utility problems, and especially in the situation which has resulted from the rising cost of labor and commodities, for which the companies are not responsible. The government has been rendering important service of this kind, enough to demonstrate its value and to show that cooperation in this work is practicable. But it could render a service of vastly greater importance to the utilities and to the public, by an expenditure say, of one million dollars per year for research and education on utility problems. That would be only one cent per year per capita of the country's population, whereas the value of the service that would be rendered to the public would possibly be fifty or a hundred times the cost.

STANDARDIZATION OF ELECTRICAL BATTERIES

One of the most productive lines of research at the Bureau of Standards recently has been a study of electrical batteries, primary and secondary. They are used in great numbers for starting and lighting automobiles, for tractors and other electric vehicles, for electrical power stations, for telephone exchanges, railway signals, door bells, flashlights and a hundred other purposes. No adequate specifications or methods of test had ever been generally agreed upon when the Bureau took up the work. They were sold without guarantee or adequate statement of performance, and the purchaser had no way of ascertaining just what he was getting. The manufacturers have cooperated cordially and intelligently in the study that has been in progress, and in time it is expected that a complete

set of specifications and methods of tests will be developed. In the meantime the manufacturers have derived important benefit from the investigation and the public is getting a better product. Possibly a hundred million dollars' worth of these batteries are made and sold each year, and if this work could be carried on more adequately and as thoroughly in all lines as it has already been in some lines, it seems a safe statement to make that the public would be benefited not less than five per cent on the entire product. This would amount to five million dollars per year, which is several times the cost of all the work of the Bureau of Standards, and more than a hundred times what the battery work would cost. This kind of research and educational work is like seed that falls on good ground and springs up and bears fruit, some thirty, some sixty and some a hundred fold.

TESTING OF GOVERNMENT SUPPLIES

For many years electric lamps purchased by the government have been systematically inspected at the factory and samples selected for life test in the laboratory. The information so obtained is utilized in the preparation and periodical revision of standard specifications which are used in the purchase and testing of lamps. Formerly lamps were bought by each department or government establishment separately, without specifications or tests. The prices were relatively high and the quality of the lamps often uncertain or poor. Electric lamps are made by highly specialized technical processes. It is very easy to make lamps that will give light, but difficult to make lamps of high quality. Since government purchases of lamps have been consolidated into large contracts and have been tested according to proper specifications, the prices have been the lowest and the quality of the lamps the highest that the market affords. The ordering of lamps by each department is now a simple routine operation, whereas formerly the separate purchasing of lamps involved dealing with agents of various manufacturers and guessing as to who offered the best values, taking into account prices and such information as was available as to quality. The systematic testing of lamps by the government not only protects the government in its purchases, but it protects the public in large measure, for the testing tends to keep up the quality of the entire product, and so benefits the public. The value of this work, which puts the purchase of lamps by the government on a business basis, and protects the

manufacturer of a high-grade product as well as the user, is many times the cost of the work. The influence of the government, instead of being hurtful as it formerly was, is thus stimulating and helpful to the industry, tending to raise the quality of the product and to improve business methods.

The testing of paper for the government is another example of constructive work which puts the government's purchases on a business basis and tends to help the industry instead of degrade it. Formerly the government bought paper in great quantities on incomplete specifications with inadequate tests. Manufacturers knew that they could supply something different from what was specified, and one who was willing to do so had the advantage over one who supplied what was called for. This was an intolerable situation which was corrected when the specifications were made adequate and tests were complete and systematic.

The value of such work is incomparably greater than its cost, and it would be well if all government purchases were as intelligently and systematically handled as lamps and paper and certain other products now are. It is proposed to establish a central purchasing bureau and to have supplies purchased and delivered in wholesale quantities and tested as to quality, instead of ordering small lots separately that can not be inspected or tested systematically. This would be a long step forward in putting the business of the government on a business basis.

TEXTILES

The textile industry is one of the largest and most important of our industries and one which concerns every man, woman and child in the country. If textiles were standardized, so that they could be bought and sold on adequate and intelligent specifications, and consumers as well as wholesale and retail dealers could know what they are buying and could get what they pay for, it would be of enormous benefit to all. Suppose the brand or name of every textile product was defined in such a way as to convey precise information, and the same name always meant the same quality. And suppose that dyes were tested and certified, and one could depend on the mark as to their permanence, and were told what conditions they would stand or would not stand. Would it not be worth hundreds of millions of dollars every year to the public to have such information? And would it not be a boon to honest dealers, both wholesale and retail? The only class to be in-

jured by such a situation would be those who thrive by misrepresentation or by selling inferior goods on their appearance without representation. It seems almost certain that money intelligently spent in research and education along the lines indicated would yield results of very great value, and while it would involve some expense and trouble, it would be constructive and wealth producing and would raise the standards of business. It seems certain that it would be as useful as the grading of lumber, or cattle, or wheat.

THE CHEMICAL INDUSTRIES

Rubber, leather, paints and the chemical industries generally, include a vast number of products which should be standardized and described in intelligent specifications. In many cases the product can be materially improved with little or no expense, if available information is utilized. Often it is the difficulty in securing information and not reluctance to use it that explains the poor quality. There are great numbers of small manufacturers who would avail themselves if they could of information to improve their product, but who can not afford to engage in expensive research to get the information. The government could supply thousands of small manufacturers with information on hundreds of subjects if an adequate staff were made available to do the work, and this would be of direct benefit to the public which pays the cost. This is cooperative work of the most practical sort, and it has been done already in enough cases to demonstrate how productive of good results it is.

SCIENTIFIC INSTRUMENTS

The manufacturing of scientific instruments has recently come to be an important industry in this country. This is partly owing to the greater use than formerly of scientific instruments in the industries, and partly to the war which has largely reduced the importation of scientific apparatus from abroad. An increased protective tariff is proposed to encourage and protect American manufacturers of such apparatus, but if there are no standards of excellence set up and no adequate specifications or guarantees, the purchaser will often be uncertain of what he is getting when he buys such apparatus. The government would do well to cooperate actively with the manufacturers and with scientific and engineering societies in standardizing and describing scientific apparatus,

so that the manufacturer will know better the properties and capabilities of his own output of apparatus, and the purchaser will know how to select apparatus and whether he gets what he orders. In other words, scientific apparatus should be scientifically described and intelligently used, and the government could render an invaluable service in aiding to bring this about. In passing, it may be remarked that the manufacturers of this apparatus will do their part in such work. They are calling for greater service from the Bureau of Standards in instrument testing than it is able to render because of lack of men to do the work.

SAFETY RESEARCH AND THE PREPARATION OF SAFETY CODES

One of the most valuable opportunities for cooperative work by the government is in safety research and education; that is to say, in studying methods of reducing accidents in the industries and in everyday life, in formulating sets of safety rules or codes, and in assisting the state industrial commissions in adopting them and manufacturers in complying with them. More than 3,000,000 industrial accidents occur every year, of which 25,000 are fatal. Many millions of dollars are expended annually by employers for accident compensation, and many millions more are lost by injured employees in wages not compensated. Nearly every state has an accident commission which supervises the collection of compensation for accidents, but many of them do very little to reduce accidents. A few states have provided their commissions with generous sums to enable them to prepare safety rules and put them into effect, and valuable results have been secured by such efforts. Recently a comprehensive program of safety work has been prepared in which many agencies will cooperate. This work includes the preparation of nearly a hundred different safety codes, covering the hazards of manufacturing in many different industries, transportation, mining, and the use of electricity, gas, machinery, and explosives by the general public. These safety codes are more than mere sets of safety rules, often amounting to a standardization of engineering practise in many aspects of an industry, and being of great value in promoting efficiency and good practise as well as safety. They are prepared by the active cooperation of all the interests concerned, including engineering societies, industrial and insurance associations, state accident boards, manufacturers of machinery and appliances, and the federal

government. The work of preparing the codes involves study and discussion, a comparison of experience and a consideration of the best operating methods. Efficiency and good service are considered as prominently as safety. Some of the more important examples of these codes are the Steam Boiler Code of the American Society of Mechanical Engineers, the Electrical Fire Code of the National Fire Protection Association, the National Electrical Safety Code of the Bureau of Standards. A national elevator code, codes for steel mills, blast furnaces, foundries, machine shops, textile mills, saw mills, and dozens of other industrial establishments are being prepared or are under consideration. The government is rendering a valuable service in this work, but the work suffers for lack of funds. The industries, the engineering societies, and the state commissions are doing their share of the work. The government's share is important and should be well done. The cost of the work is trifling in comparison with its value, and it does not seem possible that this work will be allowed to lag or cease for want of funds if the general public could but understand its immense importance and usefulness. Aside from questions of humanity and the economic value of human life, the losses in wages and the damages paid in compensation amount to so many millions annually that the small amounts required for the government's share of the work are significant in comparison. Probably no work of the government is more useful or more productive in proportion to its cost, and none is more needed by the country at large. The states and the industries are waiting to put these safety codes into effect, and the great advantage of national uniformity will result if they are prepared so well that they can come into general use. The work should be strengthened and enlarged at an early day, as a measure of efficiency and economy as well as of humanity and good government.

(To be concluded)